THIRD YEAR EVALUATION OF SEDIMENT AND FISH POPULATIONS IN SELECTED TRIBUTARIES IN ROCK CREEK AND THE BITTERROOT RIVER DRAINAGE

BY

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ABSTRACT

Fishing pressure was significantly reducing summer standing crops of westslope cutthroat larger than 6.0 inches total length in both West Fork of Rock Creek study sections. Two years after fishing was closed year-long, cutthroat increased from 9.97/100m to 21.78/100m (118%) in the upper section and from 23.14/100m to 35.62/100m (52%) in the lower section. Daly Creek did not show a similar response, non-compliance with fishing closure is the suspected cause. The magnitude of the population changes due to fisherman harvest are significant enough to mask environmental influences on these small stream cutthroat populations.

Wintering cutthroat larger than 6.0 inches total length observed, preferred high quality pool habitat. Within the high quality pools larger cutthroat were most often observed in low or negative velocity areas. No young-of-the-year and few juvenile cutthroat were observed during the night-time fall/winter dives, despite good summer densities in all three study sections. These findings provide some valuable design considerations for stream habitat improvement projects.

Two over-wintering behavior patterns were apparent in study sections. The first pattern involved adult fish living within a section of stream yearlong and the second pattern involved migration during the fall/winter and probably spring period with subsequent return in the summer. Anchor ice formation on one section and inavailability of interstitial spaces in the substrate in another section may have contributed to movement from study sections in the winter.

ACKNOWLEDGEMENTS

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A special thanks to Dennis Workman for assistance throughout the project and for acceptance of the project as an added responsibility to our Regional Fisheries program.

Thanks are extended to the fieldworkers that spent days packing gear up and down stream banks, slipping and slidding on slippery stream bottoms and often times ending up on our bottoms, and for going the extra distance when asked.

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INTRODUCTION

This study effort began as a long term monitoring effort between the USFS and the Montana Department of Fish, wildlife and Parks (MDFWP) in 1985. The MDFWP had the responsibility to provide fish population data from sections of stream that the USFS was gathering sediment (embeddedness) information on. The limited scope (small sample size and failure to account for all important variables controlling trout densities) of this cooperative effort has limited the utility of the information gathered.

To provide information with utility for evaluating land management activities the study objectives of this cooperative effort were changed for the 1987 field season. One of the obvious difficulties we have had over the 1985 and 1986 fish data collections was movement of fish out of the study sections during our census work in late summer. Movement out of the study sections has not only made population estimates difficult to obtain in a couple of cases. This movement has also created a real doubt as to the relationship of that population to the habitat measured in the study section. If the trout population relies upon different habitat in different seasons then we must know the seasonal needs to address the needs of the species.

Upper Sandbasin creek section had a summer standing crop of Wsct > 3 inches TL of 86 in August of 1986. On October 16,1986 I completed a snorkel inventory of the same section and counted a total of 8 Wsct in the entire section. In this 2.4 m wide, 100%

sand bottomed stream observing fish is relatively reliable even compared to mark - recapture estimates. My conclusion on this observation was that the fish were no longer using this habitat and had moved to another area. Similar movement seems to have taken place in varing degrees at Martin creek section, lower and upper Sleeping Child creek sections, and Moose creek sections.

In addition ODell 1985 inventoried trout populations in 28 tributaries to the Bitterroot River utilizing spring, summer and fall snorkel and mask counts. He noticed that spring population counts only accounted for 17% of summer count densities over all his study sections. Although no cause was determined in this significant change, all sections showed the low spring densities. Two of his study streams (Bear and Kootenai creeks) with the highest summer densities both had exceptionally deep pools where fish concentrated. The Bear Creek study section had a variety of good trout habitat with deep meander pools, undercut banks, log jams, clean gravels,and overhanging vegetation. However only three percent of the summer inventoried population was visible in the spring. Kootenai Creek contained two bedrock pools over five feet deep, and a long stretch of shallow boulder pocket water. ODell noticed that as water temperatures reached the thirty degree range fish schooled up in the two deep holes. Snorkel and mask inventories in Rattlesnake creek completed by Wilson and Blount (1985) indicated that unexplained disappearance of hybrid cutthroat was probably a movement into habitat that afforded the fish total visual isolation from day time observation (in the substrate or in extremely visually isolated locations). The number of fish observed by Bount and Wilson during night inventories compared favorably with summer densities. Winter cover seeking behavior during daylight hours has also been described previously by Campbell and Neuner (1985) with rainbow trout in the Cascade Range of Western Washington.

Several researchers have addressed the problem we are faced with. Binns and Eiserman 1979 developed a model called the Habitat Quality Index (HQI) to predict age I and older trout standing crops in Wyoming streams. The best HQI model explained 96% of the variation in trout standing crop estimates from 36 streams. The HQI model used a ranking system of the following nine habitat attributes: late summer stream flow, annual stream flow variation, water velocity, trout cover, stream width, eroding stream banks, stream substrate, nitrate nitrogen concentration, and maximum summer stream temperature. HQI has been used to predict potential changes in habitat as a result of water development projects, project feasibility analysis, and for evaluation of habitat improvement projects. Binns and Eiserman's model unfortunately lacks some of the variables (attributes) known to influence trout densities in this area. The most exhaustive effort of defining limiting factors on summer densities of cutthroat trout in Montana has taken place in the Flathead River basin. In the Flathead River basin tributaries Fraley and Graham (1981) found ten habitat parameters that had a significant relationship to trout density. These included six cover variables or variable combinations, substrate size(D-90),

wetted perimeter, average depth and stream order.

Shepard, Pratt, and Graham 1984 described habitat utilized by westslope cutthroat in the upper Flathead River basin. Cutthroat trout were divided into two size classes; small for fish <100 mm TL and large for fish 100-200 mm TL. Most of the data collections were completed in the summer and early fall period, so the results probably best reflect that time period. In tributaries to the Flathead river, fry and fingerlings were more abundant in pools and runs than riffles or pocketwaters. The small cutthroat used shallow areas, approximately 0.3 m deep, where water velocities were less than 0.15 mps. Small cutthroat trout were generally within 0.2 m of over head cover (provided by overhanging brush, undercut banks, water depth, large substrate or a broken water surface). The small cutthroat trout were also consistently closer to cover in the presents of other fish species or larger cutthroat trout. Cutthroat fry held near the water surface in shallow water areas using partially submerged twigs, overhanging branches and shade as cover. The larger cutthroat trout were most numerous in main channel pools. Run and pocketwater habitats were used more than shallow riffle areas. Debris (both over the water's surface and partially submerged) was used extensively as cover by large cutthroat trout. Complex cover provided by log jams, debris jams, root wads, and undercut banks appeared to be important to large cutthroat trout. They also found large cutthroat developed social hierarchies in pools. Territorial behavior was exhibited in the presence of visually isolating cover types. The social hierarchies resulted in cutthroat trout "stacking" vertically in the water column.

Leathe and Nelson (1986) felt that the exact effect each factor has on regulating a given stream population is often masked by the interaction of the other factors. They felt this complexity hampers the ability of fishery scientists to predict the response of a fish population in a given stream to environmental changes, such as increased sediment loads. In summary Leathe and Nelson concluded that accurate predictions of response to environmental variation require the development of a model that quantitatively describes the relationship between fish abundance and all regulating variables.

In the absence of such a model fishery scientists have resolved to utilize the best available information based upon simple relationships between only a limited number of the variables known to regulate fish population density. This is how the "Guide for predicting Salmonid response to sediment yields in the Idaho batholith watersheds" (USFS 1983) was developed. This guide was developed as a broad based planning document not a predictive tool for specific impacts on a given stream. If the goal of resource managers is to predict responses more specific to each stream then a much more complex model must be developed The fine tuning or calibration of a woefully simplistic model can not account for the complex of variables and variable interactions.

OBJECTIVES

1) Trout population estimates will be completed in the summer-fall period of 1987 on Daly and the West Fork of Rock Creek.
2) Identify winter habitat utilization of westslope cutthroat and bull trout in relationship to available habitat in Daly and the West Fork of Rock Creek.

PROCEDURES

Fish Populations

Fish populations were estimated with the mark and recapture method. We used Chapman's modification of the Peterson formula described by Ricker, 1975. Variance estimates were made with Chapman's formula also by Ricker, 1975. Due to the statistical consideration of acquiring an adequate sample size of fish for reliable population estimates; our study sections required greater length than the sediment stations selected by the Forest Service. However we did compromise our section lengths with the thought of maintaining similar site condition that the Forest Service had collected the sediment data on. We permanently marked our sections with steel fence posts on the lower boundary of the section. All study sections lengths were measured with a tape along thalweg. We tagged most of the trout handled larger than 4 inches total length (TL) with fingerling tags (Floy). Non-salmonids and trout less than 4 inches TL recieved a partial fin clip for short term identification.

Fall-winter Habitat Utilization

The habitat utilization work was completed by making visual counts of trout densities with snorkel and mask in the established study sections. Counts of trout were made for 2 in size groups. The location of night time densities of cutthroat were marked with flagging for subsequent measurement and classification of the habitat at the site the following day. Habitat measurements included the use of established habitat parameters when ever possible.

A tape measure or measuring rod was stretched at each pool to facilitate the linear measurement of pool width, surface substrate compostion by type, and cover available. Pool depth and velocity measurements were made at each transect at 1/4, 1/2, and 3/4 the width for large pools and 1/3 and 2/3 the width for small pools. Gradient was measured with an inclinometer over two or three long subsections within the section to give an overall estimate of mean gradient in the section.

Bottom type (I will refer to as surface substrate to more accurately define the actual measurement) was measured in the same manner as described by Platts (1979). The particle size

classifications occur in table 1. The surface substrate of each one foot increment along a transect was visually classified as that particle size that dominated the one foot increment. When we encountered equal amounts of two particle sizes we alternated the classifications. The surface substrate condition in each pool was determined by averaging the one foot tabulations of all cross sections.

Table 1, Classification of surface substrate material.

Particle diameter	classification
304.8 mm or over (> 12 inches)	boulder
76.1 - 304.7 mm (3 to 11.9 inches)	rubble
4.7 - 76.0 mm (0.2 to 2.99 inches)	gravel
less than 4.69 mm (< 0.19 inches)	fines

Pools were classified using the classification table also found in Platts (1979)(table 2).

Table 2. Pool quality rating criteria.

description	rating
Maximum pool diameter exceeds average stream width. Pool is over 1 m (3.28 ft) in depth or over 0.6 m (1.97 ft) in depth with abundant fish cover.	5
Maximum pool diameter exceeds average stream width Pool is less than 0.6 m and 1 m depth lacks fish cover.	4
Maximum pool diameter is less than average stream width. Pool is over 0.6 m in depth with intermediate to abundant cover.	3
Maximum pool diameter is less than average stream width. Pool is less than 0.6 m in depth and has intermediate to abundant cover.	2
Maximum pool diameter is less than average stream width. Pool is less than 0.6 m in depth and has no cover.	1

We used an occular method to assess the condition of the substrate interstitial spaces at each cross section. The method was both easy to use and descriptive of the interstitial environment (Table 3).

Table 3. Occular embeddedness ranking used to describe the interstitial environment.

visual characterization	ranking
sediment rare in interstitial spaces	5
some sediment visible in interstitial spaces	4
sediment easily noticable in interstitial spaces	3
sediment abundant in interstitial spaces	2
no interstitial spaces (full)	1

The measure of cover was divided into instream cover and overhead cover. Every type of cover observed in the pool was recorded and the percentage of area within the pool estimated. We noted whether or not cover types overlapped within the pool.

RESULTS

Trout Populations in Sections

Trout populations have been sampled at the same sections for the fourth consecutive year (1984 to 1987) in Daly creek and the third consecutive year in the West Fork of Rock Creek (1985 to 1987). Fishing was closed on these streams in 1986 because of concern that fisherman harvest was severely governing fish population structure and potentially masking environmental influences on the trout populations. We experienced poor compliance with the closure in 1986 and relatively good compliance in 1987. The stream sections sampled are primarily westslope cutthroat fisheries with some sections having bull trout, mountain whitefish, longnose sucker, sculpin (primarily slimy sculpin) and longnose dace (tables 1,2 and 3).

The numbers of cutthroat trout $\geq$ 6.0 in TL increased significantly in two of the three sections ($0.10 > P > 0.05$) from 1985 to 1987 (figure 1). The two sections were in the West Fork of Rock Creek. In the upper West Fork Section numbers of cutthroat $\geq$ 6.0 in TL increased from 9.97 per 100 m to 21.78 per 100 m (table 3), a 118 percent increase. In the lower West Fork section numbers of cutthroat $\geq$ 5.0 in TL increased from 23.14 per 100 m to 35.73 per 100 m from 1985 to 1987 (table 2), a 52 percent increase.

The third section, located on Daly Creek, did not show significant increases in cutthroat trout numbers (figure 2). In

Table 1. Comparison of mark and recapture trout population estimates in Daly Creek, for the years 1984, 1985, 1986, and 1987 in the section 0.65 miles upstream from the Skalkaho - Rye Creek road turn-off.

sampling date	section length (m)	species	size class (in)	marked (M)	captured (C)	recaptured (R)	number estimate (N)	95% confidence interval	number per 100 m
8-12-87	305	Wsct	4.0-5.9	8	5	2	17*	± 10	5.57
8-18-86	219			12	10	3	35*	± 24	15.98
9-19-85	219			10	19	6	30	± 12	13.70
9-05-84	168			8	13	3	31*	± 16	18.45
8-12-87	305	Wsct	6.0-7.9	13	9	5	22	± 8	7.21
8-18-86	219			16	8	5	25	± 11	11.41
9-19-85	219			12	13	5	29	± 12	13.24
9-05-84	168			11	4	3	14*	± 5	8.33
8-12-87	305	Wsct	8.0-10.9	19	12	6	36	± 14	11.80
8-18-86	219			17	14	9	26	± 9	11.87
9-19-85	219			11	3	3	11*	± 5	5.02
9-05-84	168			11	5	3	17*	± 6	10.12
8-12-87	305	Wsct	11.0-12.0	3	3	2	4*	± 2	1.31
8-18-86	219			0	0	0			
9-19-85	219			0	0	0			
9-05-84	168			0	0	0			
8-12-87	305	DV	4.0-5.9	22	8	4	40	± 20	13.11
8-18-86	219			10	14	3	40*	± 30	18.26
9-19-85	219			18	19	8	41	± 14	18.72
9-05-84	168			22	11	6	38	± 12	22.62
8-12-87	305	DV	6.0-12.9	57	35	16	122	± 41	40.00
8-18-86	219			38	14	5	96	± 55	43.84
9-19-85	219			24	18	5	78	± 48	35.62
9-05-84	168			12	10	2	47	± 39	27.98

* This estimate did not meet minimum standards for an unbiased estimate and should be used with caution (Ricker, 1975 pp. 79).

Table 2. Comparison of mark and recapture trout population estimates in the West Fork of Rock Creek for 1985, 1986, and 1987 in the section 2.28 miles upstream from the confluence with the Middle Fork of Rock Creek.

sampling date	section length (m)	species	size class (in)	marked (M)	captured (C)	recaptured (R)	number estimate (N)	95% confidence interval	number per 100 m
8-11-87	540	Wsct	2.0-2.9	2	1	0			
8-08-86				0	1	0			
8-27-85				0	2	0			
8-11-87	540	Wsct	3.0-4.9	17	23	2	143*	± 122	26.48
8-08-86				9	20	2	69*	± 29	12.78
8-27-85				24	36	7	115	± 67	21.30
8-11-87	540	Wsct	5.0-6.4	14	10	1	82*	± 80	15.18
8-08-86				20	37	11	65	± 29	12.04
8-27-85				21	16	6	52	± 28	9.63
8-11-87	540	Wsct	6.5-7.9	16	27	8	52	± 18	9.63
8-08-86				14	18	10	25	± 9	4.63
8-27-85				22	20	9	47	± 22	8.70
8-11-87	540	Wsct	8.0-11.4	11	19	3	59*	± 38	10.92
8-08-86				18	29	11	46	± 19	8.52
8-27-85				12	20	9	26	± 12	4.81
8-11-87	540	DV	3.5-5.4	4	2	0			
8-08-86				2	6	0			
8-27-85				9	5	1	29*	± 28	5.37
8-11-87	540	DV	5.5-7.4	17	9	5	29	± 14	5.37
8-08-86				11	19	4	47	± 32	8.70
8-27-85				9	14	6	20	± 11	3.70
8-11-87	540	DV	8.5-23.4	7	7	0			
8-08-86				4	11	2	19*	± 7	3.52
8-27-85				8	4	3	10*	± 5	1.85
8-11-87	540	Mwf	5.5-9.4	4	2	0			
8-08-86				5	5	0			
8-27-85				4	2	0			
8-11-87	540	Mwf	9.5-15.3	10	14	3	40*	± 31	7.41
8-08-86				20	28	9	60	± 22	11.11
8-27-85				16	14	3	63*	± 48	11.67
8-11-87	540	LnSu	3.5-5.9	20	15	3	83*	± 61	15.37
8-08-86				7	ns	ns			
8-27-85				15	23	0			
8-11-87	540	LnSu	6.0-9.4	10	6	2	25*	± 19	4.63
8-08-86				7	ns	ns			
8-27-85				5	10	3	16*	± 12	2.96

* This estimate did not meet minimum standards for an unbiased estimate and should be used with caution (Ricker, 1975 pp. 79).

Table 3. Comparison of mark and recapture trout population estimates in the West Fork of Rock Creek for 1985, 1986, and 1987 in the section 13.0 miles upstream from the confluence with the Middle Fork of Rock Creek.

sampling date	section length (m)	species	size class (in)	marked (M)	captured (C)	recaptured (R)	number estimate (N)	95% confidence interval	number per 100 m
8-11-87	381	Wsct	2.5-3.9	10	16	0			
7-17-86				3	10	2	14*	± 12	3.67
8-12-85				18	16	2	107*	± 97	28.08
8-11-87	381	Wsct	4.0-5.9	18	17	7	42	± 11	11.02
7-17-86				17	25	4	93	± 64	24.41
8-12-85				17	17	7	40	± 22	10.50
8-11-87	381	Wsct	6.0-10.9	22	35	9	83	± 23	21.78
7-17-86				27	26	11	46	± 19	12.07
8-12-85				12	14	4	38	± 25	9.97
8-11-87	381	DV	2.5-4.4	0	2	0			
7-17-86				1	0	0			
8-12-85				0	0	0			
8-11-87	381	DV	4.5-5.9	1	5	0			
7-17-86				2	5	1			
8-12-85				5	5	2	11*	± 7	2.89
8-11-87	381	DV	6.0-9.9	1	7	0			
7-17-86				4	5	2	9*	± 7	2.36
8-12-85				5	1	0			
8-11-87	381	Mwf	2.0-5.9	11	21	0			
7-17-86				8	2	0			
8-12-85				13	9	2	46*	± 39	12.07
8-11-87	381	Mwf	6.0-8.4	11	9	2	39*	± 33	10.24
7-17-86				13	3	1			
8-12-85				8	9	1			
8-11-87	381	Mwf	8.5-13.4	16	18	3	80*	± 73	21.00
7-17-86				22	2	1			
8-12-85				19	18	10	34	+ 12	8.92

* This estimate did not meet minimum standards for an unbiased estimate and should be used with caution (Ricker, 1975 pp. 79).

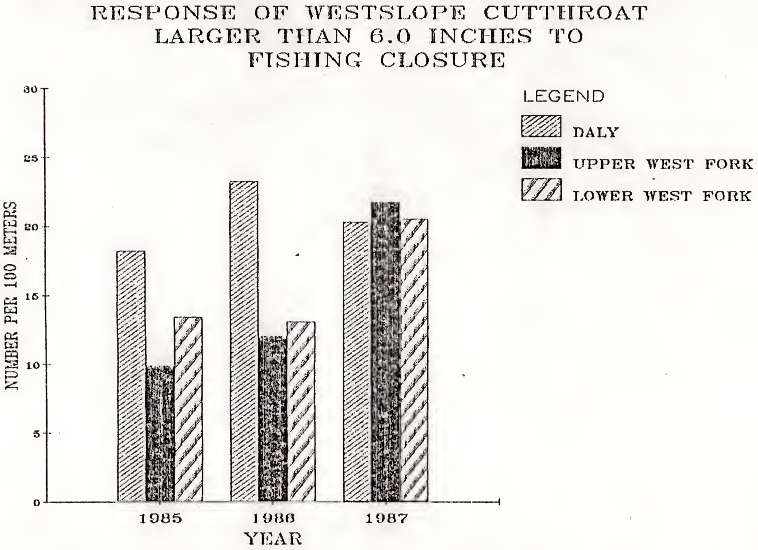

Figure 1. Response of westslope cutthroat $\geq$ 6.0 in total length to fishing closures in 1986 and 1987 on three sections located on Daly creek and the West Fork of Rock creek.

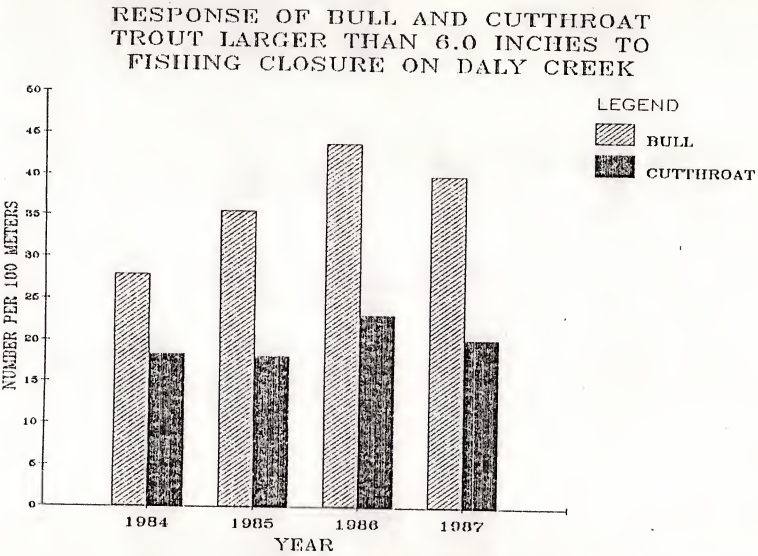

Figure 2. Response of bull and cutthroat trout $\geq$ 6.0 in total length to fishing closure in 1986 and 1987 in Daly creek.

Daly Creek abundance estimates of bull trout $\geq$ 6.0 in TL show an increasing trend (figure 3). The numbers increased from 35.62/100 m in 1985 to 40.00/100 m in 1987, a 23 percent improvement. The abundance of bull trout 4.0 to 5.9 inches TL declined 87 percent (figure 3) from 22.62/100 m in 1984 to 13.11 in 1987.

Fall/winter Snorkel Counts

No trout were observed in riffle areas during the fall/winter snorkel counts in all three sections.

Fall/winter snorkel counts of bull trout were not feasible either because they moved out of the study sections or cover seeking behavior made observation impossible. If cover seeking behavior was the cause it was not universal because bull trout observed in the sections did not exhibit unreasonable cover seeking behavior. In Daly Creek bull trout accounted for 67 % of the trout abundance in August electrofishing population estimates. Only 35 of the 113 bull trout $\geq$ 6.0 in TL estimated in August were observed in the October 1 snorkel count (table 4).

Fall snorkel counts of cutthroat trout $\geq$ 6.0 in TL completed during the evening hours of 2200 to 0200 hr compared closely with August electrofishing mark-recapture population estimates in Daly and the upper West Fork (table 4). In Daly Creek, the August mark-recapture estimate was 58 fish and the fall snorkel count 54 fish (table 4). In the upper West Fork, cutthroat trout $\geq$ 6.0 in TL in the August mark-recapture estimate totaled 76 fish compared with 60 fish counted in the October snorkel count. Comparing the 2 inch size classes (smallest grouping used in snorkel counts) in table 4, a considerably poorer comparison is obtained between the two methods and time periods.

Fall/winter observations of cutthroat $\leq$ 6.0 in TL were rare and probably do not accurately reflect actual abundance. No young-of-the- year were observed during fall/winter snorkel counts but were present in all sections during the summer electrofishing samples.

The lower West Fork section did not produce any useable fall/winter fish density information because of fish movement out of the section.

Anchor Ice in Lower West Fork

Fall night-time fish counts made on November 5, 1987 in the lower West Fork resulted in the observation of only 5 percent of the the number of cutthroat trout estimated inhabiting the section in August. A follow-up survey in December resulted in a similar low fish count. Large amounts of anchor ice were present throughout the section in December. Underwater observations of the anchor ice revealed an extremely harsh environment. The stream channel had been constricted by the build up of ice on the sides of the channel. The sides of channel appeared as walls of ice with high current velocites and at least a doubling of channel depths. The few cutthroat observed occuppied very limited low velocity spaces.

Density of cutthroat trout $\geq$ 6.0 in TL in the winter count

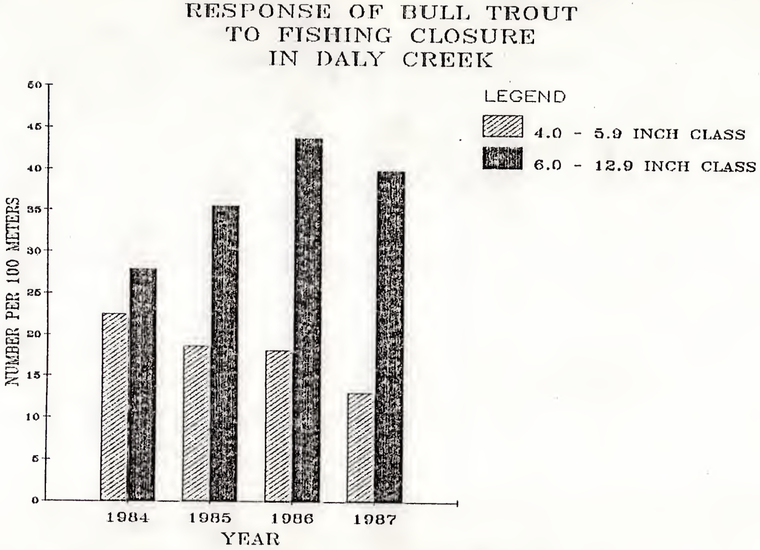

Figure 3. Response of bull trout to fishing closure in 1986 and 1987 in Daly creek.

Table 4. Comparison of summer electrofishing population estimates with the fall snorkel and mask counts in Daly Creek and the West Fork of Rock Creek, 1987.

section location	species	size class (in)	summer number estimate	95% confidence interval	summer number per 100 m	fall snorkel/mask count	fall snorkel/mask per 100 m
Daly Creek	Wsct	4.0-5.9	17	± 10	5.58	4	1.31
		6.0-7.9	22	± 8	7.22	19	6.23
		8.0-9.9	28	± 12	9.19	19	6.23
		10.0-11.9	8	± 2	2.62	16	5.25
	DV	4.0-5.9	40	± 20	13.11	3	0.98
		6.0-7.9	54	± 20	17.70	14	4.59
		8.0-12.9	59	± 27	19.34	21	6.88
West Fork of Rock Creek 2.28 mi. from mouth	Wsct	4.0-5.9	143	± 143	26.48	2*	0.49
		6.0-7.9	63	± 20	11.67	1*	0.25
		8.0-9.9	44	± 28	8.15	6*	1.48
		10.0-11.9	5	**	0.92	0*	0.00
West Fork of Rock Creek 13.0 mi. from	Wsct	4.0-5.9	34	± 16	8.92	12	3.15
		6.0-7.9	59	± 30	15.48	21	5.51
		8.0-9.9	17	± 6	4.46	27	7.09
		10.0-11.9	0	0	0.00	12	3.15

* This count included only the lower 3/4's of this section; where most of the best habitat occurs.
** No fish were marked in this size group during the marking run, however 5 fish were captured during the subsequent recapture trip.

was 1.83/100 m compared with 20.74/100 m in August (table 4).

Pool Class and Winter Cutthroat Densities

Winter densities of cutthroat $\geq$ 6.0 in TL in Daly and upper West Fork sections increased with increasing pool quality (figures 4 and 5). In Daly and the upper West Fork complex high quality pools (class 5) contained 8 to 25 times more cutthroat $\geq$ 6.0 in TL than pocket water pools (classes 1, 2, and 3). In the study sections instream cover, overhead cover and maximum pool depth correlated to pool class.

Current Velocities and Winter Cutthroat Densities

The upper West Fork a low gradient section averaged 0.75 percent gradient and Daly Creek 2.25 percent which offered a wide diversity in gradient types and current velocities. The upper West Fork section averaged 10.45 m in width and typically had laminar flows. Surface substrate is comprised of large boulders 25 %, 25 % rubble and 50 % fines and gravel. The study section has 48 % of the water surface area within the highest quality pool classification, class 5. Pools were formed by naturally occurring boulder clusters and woody debris jams. Current velocities in this section rarely exceed 0.4 m/s.

In Daly Creek the study section averages 8.93 m in width and typically had turbulent flows. Surface substrate composition in the section is 37 % boulder and 34 % rubble and 29% fines and gravel. Pool habitats within the section are predominantly in the poorer quality classes with 35 % of the section within classes 1 and 2, and only 5 % within class 5. The higher class pools are formed primarily by woody debris jams in association with boulder clusters. Boulder clusters alone produce some higher class pools with less complexity of cover. Current velocities in this section vary from 0 to 0.8 m/s commonly within each of the higher class pools.

Trout were observed predominately in low or negative velocity sites within the pool environments during the night-time counts.

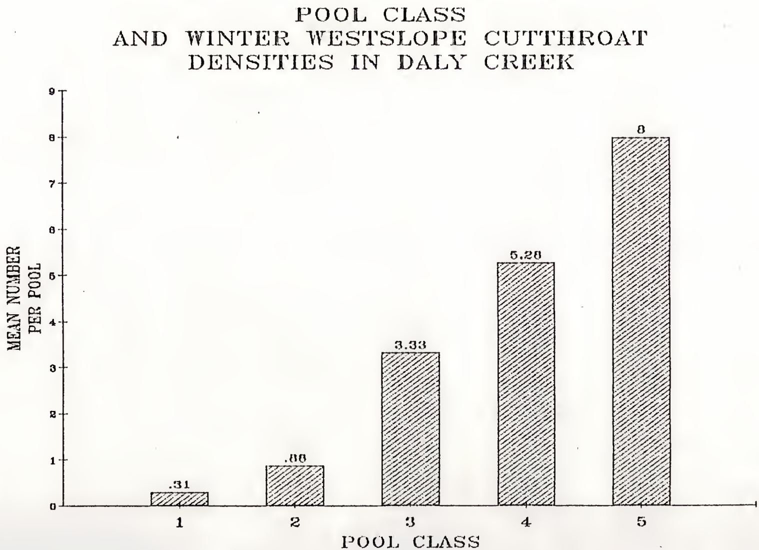

Figure 4. Mean winter density of westslope cutthroat per pool by pool class in the Daly creek study section, 1987.

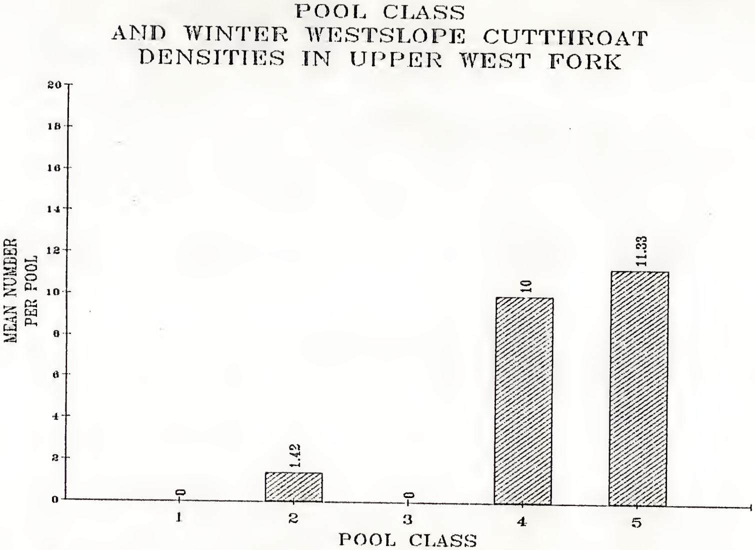

Figure 5. Mean winter density of westslope cutthroat per pool by pool class in upper West Fork of Rock creek study section, 1987.

DISCUSSION

Trout Populations and Fishing Closure

Fishing was closed on two study streams in 1986 over concern that fisherman harvest was severely governing fish population structure and potentially masking environmental influences. We experienced poor compliance with the closure in 1986 and better compliance in 1987. However total compliance did not occur even in 1987. Confusion over stream names, remoteness of the site, and poor signing all contributed to compliance problems. In spite of poor compliance the numbers of cutthroat trout $\geq$ 6.0 in TL increased significantly in two of the three study sections, both in the West Fork of Rock Creek. The Daly creek section would probably also show significant improvement with better fisherman compliance to the closure. A single limit of fish taken from that study section would decrease the population enough to cause failure to surpass the 95 % confidence interval. In the West Fork sections populations of cutthroat have increased 118 and 52 percent respectively.

Fishing pressure had significantly reduced standing crops of cutthroat in the West Fork and probably in Daly creek. Recovery of the cutthroat populations to full potential is probably not complete as of this report. Furthermore the magnitude of population improvement to 1987 would indicate that environmental influences on these cutthroat populations may not be noticable until harvest related impacts are reduced.

Fall/winter Snorkel Counts

Fall/winter snorkel counts of cutthroat trout $\geq$ 6.0 in TL completed during the evening hours of 2200 to 0200 hr compared closely with August electrofishing mark-recapture population estimates in Daly and the upper West Fork. Fall/winter trout densities in the lower West Fork section declined significantly below August densities. Within the three study sections two overwintering behaviors is apparent: (1) overwintering in or near summer habitat and (2) movement away from summering areas. Wintering areas for the lower West Fork trout were not identified. The movement from the summering area probably related to the severe anchor ice problems observed in December within that section. Similar movement was observed in upper Sand Basin creek in 1986, a 100 % sand bottomed stream within the West Fork drainage. Snow bridges this stream by late fall and probably prevents anchor ice formation but the 100 % sand substrate does not accomodate movement into interstitial environments. The importance of this finding is that cutthroat and bull trout have summer and winter habitat preferences which may or may not be fulfilled within the same section or stream. The studies necessary for identification of summer and winter habitat in each stream are possible but not practical. The most practical solution is minimizing impacts to stream systems.

Wintering cutthroat observed in this study preferred high quality pool habitat. Within the high quality pools fish were most often observed in low or negative velocity areas. Density of cutthroat within high quality pools seems to relate to escape cover immediately available and in adjacent habitat. For example, two high quality pools adjacent to each other or a high quality pool surrounded by deep fast runs would carry more fish than two high quality pools isolated from each other by a shallow riffle. This observation has significance in the design of habitat improvement projects for adult cutthroat in streams. High quality pools and linking structures together in clusters should be preferred over spreading structures and use of designs that will only create low quality pools.

Young-of-the-year cutthroat observed in August electrofishing surveys were not observed in any of the three study sections during the fall/winter snorkel observations. I suspect the young cutthroat used intragravel habitats even during evening hours. The use of the substrate so extensively by young cutthroat highlights the importance of maintaining free matrix particles in the substrate. The determination of where these young trout use this habitat was not documented and would be helpful to better define monitoring programs for them.

RECOMMENDATIONS

Since standing crops of cutthroat trout still appear to be recovering from years of harvest the closures should remain in affect and annual evaluation maintained. The streams should recieve better signing to improve compliance with the closures.

Destination of trout migrating from upper Sand Basin and lower West Fork should be identified.

Habitat utilized by juvenile and young-of-the-year cutthroat should be identified.

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